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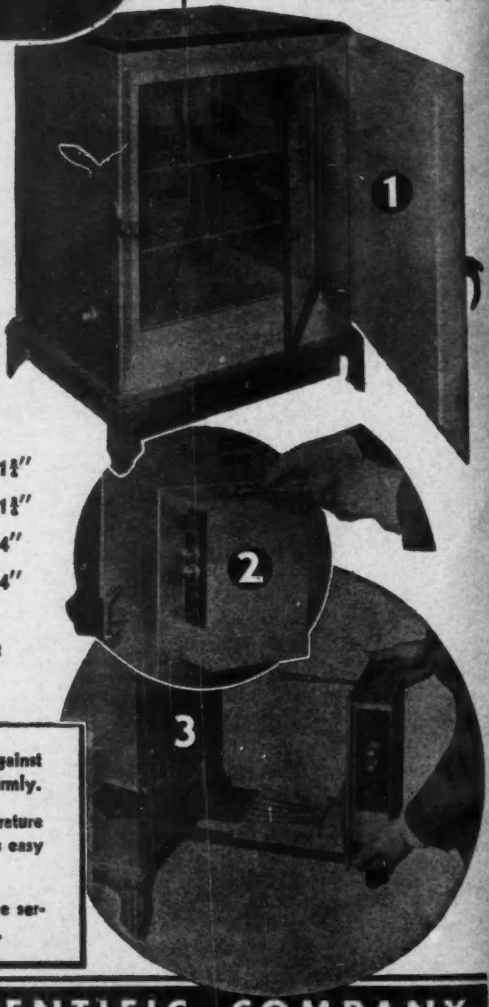

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The Community Dental Program

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THE long-held concept that teeth were inert pegs, incapable of influencing or being influenced by general health, persisted in the minds of most—physician, dentist and layman, alike—until well into the present century. Then, some forty years ago, there took place an event, here, in Montreal, that was to stir the interest of the medical and dental professions in diseases of the teeth and their supporting tissues as nothing before in the history of medicine had been able to do.

On October 3, 1910, William Hunter, speaking before the Faculty of Medicine of McGill University, delivered his epochal paper, "The Role of Sepsis and Antisepsis in Medicine". Hunter was concerned, for the most part, with the effects of dental infection upon health. His ringing condemnation of "the mausoleums of gold over a mass of sepsis" was heard around the world. Almost overnight, "focal infection", which was to become the gloomy epitaph of countless thousands of man's teeth, loomed ominously on the health horizon. The teeth quickly came to be blamed for almost every malady imaginable, from anaemia to xerostomia.

In the light of advances in scientific knowledge concerning health and disease over the past four decades, we may not, today, agree with a number of Hunter's conclusions. Nevertheless, his paper remains an important land-mark in medical science, for it provided the first real stimulus to the study and research from which has grown recognition that there *is* an important relationship between dental health and health, generally.

Presented at the thirty-ninth annual meeting of the Canadian Public Health Association, held in Montreal, May 28-31, 1951, in conjunction with the annual meeting of La Société d'hygiène et de médecine préventive de la province de Québec.

It has been known, vaguely, for a long time that dental diseases—notably dental caries and periodontal disease—were among the commonest afflictions of the human family. Only in the past ten or twelve years, however, have we begun to be aware of their prevalence, and of the enormous impact of dental ill-health on the community. We know, now, that dental caries is almost universal in its prevalence; that, in Canada, no more than two or three people in every hundred escape its ravages entirely, throughout life. There is increasing evidence that periodontal disease is but little, if at all, less wide-spread. Today, the problem of dental ill-health is the most extensive and, at the same time, the most neglected, problem confronting us in the ever-widening field of public health.

The problem begins early. Dental caries, the major hazard to dental health in childhood and adolescence, occurs almost as soon as children are old enough to have teeth to be attacked. One tooth, or several, may be attacked at a time. Few children appear to have natural immunity to this disease, and one attack confers no immunity to subsequent attacks. By the time they reach school-entering age, more than half of Canadian children have one or more decayed teeth. As chronological age increases, caries-prevalence soars rapidly, until, by age eleven, it is found to exceed ninety per cent. And, up to age sixteen, at least, there appears to be a direct linear relationship between caries attack-rates and age; caries tends to attack on the order of 1.5 additional tooth-surfaces per child per year. A tooth, once attacked by caries, has no powers of self-repair; the longer the neglect, the more serious each defect becomes. Consequently, through neglect alone, dental treatment needs are increased, and the costs of meeting those needs multiplied.

The dental problem grows like a snowball; it increases like compound interest. The common pattern, in the absence of timely care, is tooth decay, pain, infection and tooth-loss. In addition to the obvious contribution made by dental infection to ill-health, premature and continuing loss of teeth during childhood contributes to malocclusion, malfunction and facial deformity. In varying degrees, normal mastication, swallowing, speech, hearing and breathing may be affected. This early loss of teeth also becomes a predisposing cause of periodontal disease, the dental public enemy number one of adult life, and the cause of most tooth-loss in persons past the age of thirty.

Control and solution of the dental problem will not be achieved easily. There are a number of obstacles along the road to improved community dental health. First, of course, is the fact that virtually the entire population is affected by dental diseases. Next, the fact that control of dental caries, to be successful, depends on treatment being instituted early and repeated thereafter at regular, periodic intervals. Dental care requires therapeutic procedures that are not readily adaptable to mass treatment; hence treatment is time-consuming and costly. Efforts at prevention of tooth decay have been hampered, in the past, by the lack of scientifically proven preventive measures that might be employed on a mass-population basis. Indifference to dental health has resulted in a burden of neglected, untreated dental disease so great that there are not sufficient dentists available to meet the present treatment-needs of the entire population.

And these needs are staggering. Their full extent in the population as a whole can only be guessed at, but some measure may be gained from the follow-

ing data. There are approximately three million Canadian children between the ages of three and fourteen years. On the basis of recent caries-prevalence studies it has been estimated that they, alone, have a total of twenty-one-and-a-half million untreated, decayed tooth-surfaces. In order fully to meet the treatment of this group, comprising about one-fifth of the entire population, the full operating-time of 7,200 dentists would be required for a period of one year—half again as many dentists, by the way, as Canada has available to attempt to meet the dental health needs of her *whole* population.

Eradication of the existing back-log of untreated dental disease is, plainly, a physical and economic impossibility. And as long as dental caries—to say nothing of periodontal disease—continues to occur at the rate of some six times that at which it is being treated, the control of this disease will remain an impossibility. On the other hand, much can be done, even with present resources, to prevent the occurrence of a similar back-log in the future.

The struggle for good dental health must be won or lost in the first few years of life. It is here, at the problem's source, that the community dental program should begin its attack, if it would eliminate the possibility of accumulated dental treatment needs again becoming the burden they now present. Starting with the generation of children just now reaching pre-school age, the objective should be the prevention of dental caries, and the minimizing of the consequences of those cases which do occur, despite all efforts to the contrary, by controlling this disease at the earliest possible stage.

The community dental program that concentrates its efforts and activities on health education alone might, in time, succeed in improving community dental health. But the program based upon the provision of dental treatment, alone, will accomplish little of lasting benefit to dental health. Dental services—whether provided at private or at public expense—are a necessary and important feature of the dental program. The fundamental job of the community dental program, however, is to make the community aware of the high costs of personal dental neglect, whether in ill-health or in dollars, and of the fact that they are largely unnecessary and avoidable costs. The program should seek to keep every citizen well-informed as to the most effective uses that can be made of all existing means of controlling dental caries and other dental diseases, and should strive, through health education, to create an intelligent demand for dental care; a demand that will be based on knowledge and understanding of the basic principles of dental health, together with an appreciation of the positive advantages to health, of sound teeth and gums.

The importance of dental health education will increase as research develops further knowledge of the means whereby caries can be prevented. Even now, at least three effective methods of reducing the incidence of caries exist: restriction of sugars in the diet, toothbrushing immediately after eating and—in the case of children under fifteen—topical sodium fluoride applications to the teeth, all have an inhibitory effect on tooth decay. There is promise, for the future, that the fluoridation of communal water-supplies will provide yet another effective method of reducing the incidence of caries. It should be made perfectly clear, however, that none of these procedures offers a single, simple solution to the

dental problem. Each will prevent some tooth decay; none will prevent it, completely.

The immediate, pressing need is for the reduction of the prevalence of untreated dental caries, by extensive application of the most dependable procedures available, namely early diagnosis and prompt treatment, beginning before this disease has become well established.

The approach to this phase of the problem should be evolutionary. If limitations must be imposed on the dental program because of lack of funds or a shortage of personnel, the facilities that are available should be utilized on the basis of the number of children whose treatment needs can be met on a current basis, rather than in terms of securing limited dental services for the largest possible number of children. The program should start with the youngest age-group in the community for whom local circumstances make possible and practicable the obtaining of complete treatment of existing needs during the first year, and whose recurring needs can be met thereafter on an incremental or "annual crop" basis, from year to year.

During the second year, the new starting group should be included, the aim as before being to secure complete dental care. In addition, the original starting-group of children would continue to participate. Now, however, they would require dental treatment only to the extent necessary to deal with one year's increment of tooth decay—a treatment load that would be predictable, since it is known that new caries occurs at the rate of approximately 1.5 additionally attacked tooth-surfaces per child per year. The program should be continued with the inclusion each year, or as circumstances make possible, of children in the starting age group for complete initial care; the groups previously admitted to the program should continue to receive such annual maintenance care as required.

Such an approach is, admittedly, a long-term, long-range proposition, but it is the only logical and practical approach, in view of the obstacles with which the pathways to control of this disease are beset. It offers, to the average community, the means whereby a constructive start can be made, using its available resources, facilities, and dental manpower, in the most efficient, most economical manner, against the problem of accumulating dental defects. At the end of ten years, the community dental program that has attacked its dental problem consistently and continuously in this manner will show a more lasting benefit to dental health in its school-age population than can be achieved in any attempt to stretch existing facilities in a widespread but futile effort to meet all the existing treatment-needs of its entire school-age group at once.

In most instances, children will receive needed dental care considerably earlier, and with greater frequency, under such a program, than is generally the case, at present. No longer will untreated dental defects have the dubious and unenviable distinction they have long held, of being the most overwhelmingly neglected health defect in Canadian children of school-age. No longer, that is, if the community makes a start, now, with its new generation of children.

To wait until tomorrow will be to wait too long. Tomorrow, it will be too late.

The 1951 Census of Canada

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ONCE every ten years since Confederation a census of the people of Canada has been taken. The first of these decennial censuses, as they are called, was taken in 1871: the ninth will be taken in June 1951, and will enumerate a population over a fifth larger than any previously recorded in Canada.

The 1951 census will be a census of population, housing, agriculture, fisheries and distribution. It will be a yardstick in determining the progress that Canada has made in the first half of the twentieth century, and will be of aid to government, business, public health, social welfare, justice and education.

In Canada the fundamental legal reason for the taking of the census is to be found in the British North America Act of 1867 as amended in 1946. By this legislation, representation was assigned to each province on the basis of "dividing the total population of the provinces by two hundred and fifty-four and by dividing the population of each province by the quotient so obtained". If the number of members thereby assigned to each province should be less than the number of senators for that province, then the number of Members of Parliament for that province are increased to equal its number of senators. This is the case with Prince Edward Island. In addition Yukon was awarded one member and in 1949, on the entry of Newfoundland into Confederation, provision was made for seven members for the new province. Readjustments are to be made after each decennial census so that, should the population of any province have increased or decreased by the amount of the quotient mentioned in the Act, that province will have its representation in Parliament increased or decreased accordingly.

A second reason of great importance from a provincial standpoint is the fact that a number of the federal subsidies to the provinces are based on population. The original subsidies granted under the British North America Act are all based on population. Subsequently, the tax agreements entered into with seven of the provinces are predicated, amongst other things, on population increases in relation to other factors.

The census is the government equivalent of the business inventory. The primary asset is the population itself, not merely the number of people but the various attributes that collectively make the Canadian people different from those of other countries. Data about sex, age, occupation, origin, language, years of schooling, etc., are facts in themselves of the greatest moment. They constitute

Presented before the Vital and Health Statistics Section at the thirty-ninth annual meeting of the Canadian Public Health Association, held in Montreal, May 28-31, 1951, in conjunction with the annual meeting of La Société d'hygiène et de médecine préventive de la province de Québec.

the background against which almost all other facts must be projected if the latter are to have any real significance.

In the allocation of grants by provincial authorities for educational, health and other purposes, population figures for rural and urban divisions are required by provincial governments. Occupational statistics are useful to these same provincial authorities in setting up such things as public health services and arranging for highway development.

Many new "avenues of approach" have been developed in an attempt to improve the quality of the census data collected in 1951. The situation with regard to "occupations" will serve to illustrate the sort of job that has been done during the planning stages.

In previous censuses, one of the most difficult and frustrating tasks has been that of trying to secure occupational data which are not biased by a considerable amount of inaccuracy. This is caused mainly by ignorance on the part of the respondent—the housewife, landlady or other person invariably gives the information to the enumerators—who seldom knows the occupation of the individuals who make up the household by a job title, which can be properly assigned under a meaningful occupational group and rubric. In an attempt to correct this situation, every business establishment in the country is assisting the census by instructing the workers about their individual "job title". It is hoped that in this way the quality of the 1951 occupational data will be greatly improved.

Thus the census supplies basic information which enables government at all levels—federal, provincial and municipal—to work more effectively and economically in the interest of the country. The census plays an important role in providing data of use in formulating legislation and conducting the administration which might otherwise be carried on in the dark.

Besides government, there is scarcely a branch of business activity—manufacturing, selling and financing—that does not have specific uses for census figures. These are as important to business as they are to government.

Origin, language and religion figures are useful to schools of social work, social agencies and societies interested in the improvement of social conditions generally, as well as to church authorities in the planning and location of new churches, church buildings and schools. Teachers and students, authors and lecturers and many other private citizens write to the Bureau for population figures, and the United Nations and its agencies reproduce in statistical publications material supplied from the censuses of many countries.

Eight documents will be used in the 1951 Census of Canada. These deal with (1) population, (2) blind and deaf, (3) housing, (4) agriculture, (5) irrigation, (6) live stock and green houses elsewhere than on farms, (7) commercial fishermen, and (8) distribution.

The population card has 29 questions to be asked of each person by the enumerator who will thereby record the social and economic characteristics, such as age, sex, marital status and occupation of every individual. This schedule was drawn up in consultation with other government departments since the information it contains will be of great administrative importance to each. The recommendations of the United Nations Population and Statistical Commissions regarding the standards as to types of data to be obtained and the definitions to be used, were also taken into account.

The census of the blind and deaf is used primarily to determine those who, in this respect, are completely incapacitated—their ages at the census and the age at which their disability occurred. This record supplements the information obtained from the population card and facilitates the work of educational and other institutions for those handicapped by such disabilities.

The housing census gathers data on the physical and occupancy characteristics of the dwelling in Canada—such as the number of rooms, the source and nature of the water supply, the tenure, the monthly rent, etc. Material is collected for every fifth dwelling rather than for all dwellings, in the interests of economy and facility of tabulation.

The general farm schedule of the census of Agriculture will record information about the farm operator, the location, area, tenure and agricultural operations of the farm. This schedule was drawn up in consultation with the Dominion and Provincial Departments of Agriculture and other agricultural authorities, and in the light of suggestions made for a World Census of Agriculture by the Food and Agriculture Organization of the United Nations. Owing to its limited agricultural activity, there will be a separate smaller agriculture schedule for Newfoundland.

The enumeration booklet for commercial fishermen records whether they are fishing on their own account, on shares or "lay", or for wages in four groupings according to the number of days spent in fishing. This information will provide the basis of a partial survey to be taken later in the year.

On the enumeration folio for the Census of Distribution, the enumerators will enter details concerning the name, address, kind of business, and relative sales-size classification of all retail, wholesale and service establishments. This will provide a mailing record which will serve as a basis for the conduct of a mail questionnaire survey early in 1952.

The irrigation schedule is applicable only to those sections of Canada where irrigation is an important aspect of the farm picture, and will supply basic data, for the government departments concerned, of the acreages affected and other relevant facts.

The administrative aims in any census are threefold: *to attain quality in the information with regard to accuracy and completeness; to keep costs as low as possible; and, with full consideration for quality and cost, to issue the results as quickly as possible after the date to which they refer.*

The new methods which have been devised for the Canadian Census of 1951 have been directed at all stages towards accomplishing these administrative objectives. Two lines of approach were followed in developing them. On the one hand, consideration was given to the mechanical aids which could be utilized; on the other, to the organization which would be best suited to the collection and processing of the material.

On the mechanical side, the most spectacular innovation in 1951 will be the application of principles, already established, which enable the census facts about a person to be recorded on a card which can be read directly by a machine. This is the biggest single mechanical development in the 285 years during which censuses have been taken in Canada.

The first "modern" census was taken in New France in 1666, the population enumerated at that time being 3,215 persons. This early effort, while a mere

shadow of the present-day operation, is of interest here because while many countries have laid claim to "the First Census", it was, in actual fact, the first to introduce the personal canvass. It, too, introduced the "de jure" principle and included the name, age, sex, conjugal condition and occupation of the people. In 1667, the very next year, the Census was repeated and inquiries regarding such details as areas under cultivation and the numbers of sheep and cattle were added. The so-called censuses in other countries appeared for the most part to be "a tally" made from the continuous population registers of births and deaths.

So it will be seen that while the population has increased, the area of "Canada" has been extended and many new developments in machines have gone into the present operations, the basic principles of modern "census taking" still remain in the system.

In the past, the enumerator who went the rounds of all the households in the area allotted to him wrote down what people told him on large sheets which provided a line for each person. Some enumerators wrote well and some wrote badly. Regardless of the legibility of the entries, they had to be read by someone. In the last four censuses the information was transferred to punch cards by census employees known as key-punch operators, and with the varying quality of the material this was a slow task. Before some of the written words could be punched, they had to be reduced to numbers in an operation known as coding. However it was tackled, this operation was a big job by the time the population of Canada had risen to 10,000,000. Furthermore, without an elaborate checking scheme that doubled the task, errors in serious amount would enter the work during the processing.

In collaboration with a large manufacturer of business machines, the Bureau has worked out for the 1951 Census a process whereby the information put on a document by the enumerator can be converted to a punch card mechanically. As the first step in this process, the enumerators will enter the particulars of each person on what the technicians call a mark-sense document. This is a piece of cardboard about the size of a page in an average-sized book printed so as to provide spaces which describe the various characteristics of the people who are the population of Canada. One census question, for instance, asks the province or country in which the person was born. The space provided on the document for answers to this question contains a number of ovals—one marked "Newfoundland", one "Prince Edward Island", and so on for each of the provinces of Canada, and one marked "England", one "United States of America", etc. The enumerator makes a mark in the appropriate oval with a pen using a specially designed ink which is capable of carrying an electrical current. When passed through it, the card will be "read" by the machine and in this mechanical reading many of the human errors which can creep in at this stage will be avoided. The machine has a set of brushes or small metal fingers which sweep down the several columns of the document. When they come to an ink mark in a particular column, an electrical circuit is closed and the resulting impulse causes a die to punch a hole in a punch card, which has eighty columns. The card will be punched in about one second for all the entries which have been made by the enumerator in describing a particular person.

The development of this mechanical procedure has required a considerable amount of inventive activity. It was necessary to invent a machine which could

read the mark-sense document, an ink which would conduct electricity, and a pen which would feed the ink.

The bundles of documents completed by the enumerators will be fed through a machine which will make punch cards from them in the manner described, at the rate of about 50 per minute. Once these punch cards are made, they will be checked by another machine to see if they are correct. For the first time in a census, a machine is available which compares the various entries made by the enumerator as represented by the various holes on the punch card. The machine can be set to make many different comparisons at one time and to throw out, for individual examination, cards which show an unlikely combination of characteristics. For example, it will reject cards with an occupation for a person who is under fourteen years of age; it will examine cards to see whether someone with an occupation requiring a great deal of training, such as a doctor, has a predetermined minimum number of years of schooling punched in the space for education. The machine examines cards for many such inconsistencies simultaneously at a rate of 450 per minute, i.e., 7 each second.

The principal piece of equipment to be used in making the actual count itself, as distinct from the preparatory work of punching cards and editing them, will be the same one as was used in the editing process. Like other punch-card equipment, this machine has a set of brushes for 'reading' the card, one to read each of the eighty columns. In this case, too, the cards are 'read' in less than 1/7 of a second.

When the brushes which sweep down the several columns of the card come to a hole, they make an electrical contact which initiates the action that the machine has been 'instructed' to carry out. The principal kind of action is moving a counter. For example, the counter adds an additional unit to the count of persons having six years of schooling when a punch card fulfilling this condition is passed through the machine. At any one time, the machine can keep track of 60 different and unrelated counts for the cards being examined. After a group of cards has been run through, the machine is 'instructed' to disclose these counts which it has been 'remembering' by printing out the totals in the 60 different counters on a single line of tabulation sheet. This printing operation is done with a typewriter ribbon and type bars, and in about 18 seconds all sixty totals are available in printed form.

But counting 60 single facts of this kind is only a small part of what the machine can do with a single reading of the cards. It can also count the number of persons who fulfil a combination of conditions, say the number who speak French, have five years of schooling and live on a farm. The machine contains a large number of relays (or switches) which by suitable wiring can be used to bring together the facts which are contained on the card in the form of punches. One switch is made to close for cards punched 'French' under language spoken, and another for cards punched 'five' under years of schooling and yet another for cards punched 'farm' under residence. It is now easy to connect the current to some counter through all three switches so that only when all three conditions are fulfilled will the card being examined be counted.

While the cards are being 'read', at the rate of 7 every second, and the machine is storing up the counts of the various characteristics, they may be routed into one of 12 pockets corresponding to 12 unrelated characteristics or

combination of characteristics. This will not serve any purpose in the particular count which is being made but will save time for the next count. The reason that sorting is important is because the counts are not made for punch cards representing all the persons in the country but only some specific group. For instance, the 60 counts which the machine is capable of making in a single pass of the cards may be for a particular town, or for all the persons in a particular province who live on farms and are 25 to 34 years of age. The work of tabulation is so arranged that during the first count the electronic statistical machine arranges the cards into the groups that will be required in the second count.

While the use of the mark-sense cards in the field and electronic machines in the processing is the greatest change on the mechanical side, the main difference from the traditional census-taking methods on the organizational side is the use of six regional centres across Canada for the major part of the office work. No longer, as in the past, will the clerk in Vancouver, for instance, be brought to Ottawa along with the schedules which are to be processed for British Columbia. The whole work will be carried out in premises to be rented for a few months in Vancouver, Winnipeg, Toronto, Montreal, Halifax and St. John's. The original schedules completed by the enumerator will be processed in these centres and the punch cards prepared for later tabulations. A microfilm record of the original documents will be made for future reference and the documents destroyed. Only the punch cards will be sent to Ottawa, where a small staff will tabulate, assemble and publish the results.

Careful study has been given to the organization of the field force, so that it fits closely with the pattern of decentralization. In past censuses, the enumerators were left on their own to a large extent and little or no assistance was available to them in the way of technical advice or to meet emergent situations. The quality of the work sometimes fell below the level which should be met.

The training and supervision of the enumerators in 1951 has been planned with quality of results in mind. A group of about 30 master trainers who had become thoroughly familiar with all phases of the field work was assembled. In the month preceding the census date these master trainers instructed 262 commissioners and 850 field supervisors in training centres from coast to coast. The final stage in the training program was the instruction of the enumerators by the field supervisors during the week immediately preceding enumeration. Each field supervisor will be responsible for about 20 or 30 enumerators and each of these groups will become thoroughly familiar with the instructions, particularly as they relate to individual localities.

During enumeration, the field supervisor will give constant direction and assistance to his group of enumerators. At all times, the trained staff of the regional offices of the Bureau will be available to meet emergencies and straighten out problems. In this way, errors can be corrected while the job is in its initial stages and before wrong practices have seriously affected the results of enumeration.

This brief description of the 1951 Census of Canada has shown that full consideration has been given to improving its three main administrative aims. It is hoped that the combination of mechanical aids and efficient organization will ensure, at a minimum of cost, accurate and complete results which will be published as quickly as possible after the date to which they refer.

Quantitative Serologic Tests for the Diagnosis of Syphilis and Control of Treatment

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THE demonstration by Dr. John Mahoney and associates, in 1943 (1), that early syphilitic infection is curable by penicillin in eight days has brought radical changes in the treatment of the disease and in the evaluation of its public health significance. The successful application of penicillin therapy necessitates an accurate determination of the reagin titres of positive serums; to this end, and also in order to provide valuable aid in diagnosis, quantitative procedures have been added to the usual serologic techniques for testing blood.

For the control of syphilis as an infectious disease, penicillin has proved to be the drug of choice. This antibiotic, applied to more than 500,000 tabulated cases of primary, secondary and early latent syphilis, has been found almost equal in its curative effects to arsenic and bismuth administered over a period of months in primary infections, and of years in secondary and latent cases.

Even should a higher rate of failures be expected after one course of penicillin (15 per cent) than with adequate chemotherapy (10 per cent), the latter treatment loses most of its relative value from the public health standpoint by reason of the fact that all syphilitics diagnosed complete their treatment with penicillin whereas, with the older methods of prolonged therapy, 50 per cent lapse from treatment, or receive subcurative doses on account of severe reactions. As a consequence, the rate of failures, most of these accompanied by infectious relapsing lesions, is raised from 10 to 55 per cent with chemotherapy; whereas it remains at the 15 per cent level with penicillin, including reinfected patients as well as those whose infection has resisted 6.0 million units. In practically all cases retreatment with higher dosages of penicillin is successful; it surely prevents any infectious relapse, when applied in time according to the indications given by the results of quantitative blood tests which should be repeated at monthly intervals after the initial treatment (2).

Quantitative and Qualitative Techniques

The course of syphilitic infection is characterized by the appearance in the blood and in the spinal fluid of a reactive substance, which has several of the properties of an antibody: it has been called "reagin". The aim of qualitative tests is to reveal the presence of reagin even in minute quantity, and, to attain sensitivity, the largest safe amount of serum (or spinal fluid) is introduced in the reaction. In the quantitative procedures, serial dilutions of the original dose

Presented before the Venereal Disease Control Section at the thirty-ninth annual meeting of the Canadian Public Health Association, held in Montreal, May 28-31, 1951, in conjunction with the annual meeting of La Société d'hygiène et de médecine préventive de la province de Québec.

of serum are individually tested for the purpose of evaluating the amount of reagin the serum contains and therefore its degree of positivity.

High reagin levels of 1,000 or more units may be revealed by the quantitative reactions; these are not indicated by the routine qualitative tests which reach their maximum of positivity with the relatively low levels of 4 to 8 units. The latter are maintained at this high degree of sensitivity for the purpose of raising, in the mind of the clinician, the suspicion of syphilis whenever detectable amounts of reagin are found in the blood. The ++ and +++ Wassermann and Kahn reactions indicate barely detectable quantities of reagin and have very little significance (3).

Methods of Reporting

The series of two-fold dilutions of serum which are applicable to various techniques is as follows; we have chosen the quantitative Kahn test because of its general use in most laboratories. Dilutions: 1:2; 1:4; 1:8; 1:16; 1:32; 1:64; 1:128; 1:256. The greater the dilution giving a positive result, the higher is the degree of positivity of the serum.

A serum which reacts up to dilution 1:32 but fails to give a definite reaction with greater dilutions, should be reported positive with a titre of 32, or 32 "dils" (a contraction of the word "dilution"). This method, advocated by Harris (4), is simple, adequate and accepted by most laboratories; it is one now followed in the laboratory of the Ministry of Health, Province of Quebec.

The titre of the highest reacting dilution multiplied by four gives the number of "Kahn units" contained in a positive serum; for example, a serum with a titre of 32 is considered to contain 128 "Kahn units". Should this arithmetical ratio apply to all techniques, the reagin unit, so often referred to in statistics, might serve as a practical term of comparison; but it is not, since the unit of one testing procedure may not have a constant relationship to the unit of another test: with the Kline test, the reagin unit corresponds exactly to the dilution titre (titre of 4 = 4 units), whereas Kahn allows 4 reagin units per dilution (dilution titre of 4 = 16 units). Obviously, reporting in terms of units is confusing and, therefore, undesirable.

Variations in Reagin Titre

Reagin appears in the blood as early as the 4th week after infection; in rare instances it is not detectable before the 12th week. The curve of reagin titres increases rapidly, reaches a peak, usually above 64 dils (256 Kahn units) during the secondary period, and remains at a lower but fairly constant level afterwards. Even in the acute stage of syphilis there are wide variations, from low titres up to 256 dils or more, in the reagin contents of serum; obviously the ability of infected individuals to produce antibodies differs greatly. A high titre is therefore indicative neither of the stage nor of the severity of the disease; in late syphilis low as well as high blood titres may be associated with serious manifestations of neurosyphilis or cardiovascular syphilis.

The Serologic Curve as a Guide for Treatment

The interpretation of the serologic curve obtained after treatment at various stages of syphilis is of paramount importance. Unless the physician knows the

serologic result to be expected, his management of the syphilitic patient may be at fault. In many instances unnecessary treatment follows a wrong interpretation of positive serologic results, particularly in sero-resistant cases.

In Primary or Secondary Syphilis, the serologic curve falls rapidly after penicillin treatment, and blood tests usually give negative results within 6 to 9 months. A few of these patients, however, and a large percentage of those successfully treated during the *early latent stage,* will not become completely sero-negative before two years. At the end of twelve months their serologic curves have declined to the low levels of 1 or 2 dils, 4 to 8 Kahn units; these low titres usually disappear spontaneously during the following year of observation.

Therapeutic Failures

In early syphilis retreatment is indicated for those cases that retain, after 9 months, the relatively high blood titres of 8 dils or more (dilution 1:8 and higher, which means 32 or more Kahn units).

Quantitative blood tests repeated monthly after penicillin therapy will readily indicate the rare cases which do not respond to the initial treatment of early syphilis. If the serologic titre remains practically the same during 3 months, a second treatment should then be applied with a higher total dosage of penicillin.

Serologic relapses may occur from the 4th to the 9th month or later, but exceptionally after the 18th month. These are revealed by the serologic curve which, after a normal decline to lower levels, shows a definite rising trend in serologic titres. The serologic relapse must be confirmed by several tests the results of which should show titres, say, four times higher than the lowest one previously reached; it may precede by days or months the appearance of clinical signs.

In Late Syphilis of more than Two Years' Duration

The attainment and maintenance of sero-negativity is one of the aims of treatment in early syphilis, but not in late infections where a trend towards lower levels in serum titre, absence of symptoms, and a normal spinal fluid are sufficient indications that the syphilitic process has ceased to be active. It is futile to keep treating late syphilis beyond the therapeutic point which experience proves to be adequate, for the sole purpose of reversing to negative a resistant positive serology.

It has been observed in late cases that the serologic response is more rapid when the initial reagin titre is high than when low. Penicillin therapy is to be considered particularly successful whenever the serologic curve declines within a year or two to reach levels below 32 dils (serum dilution 1:32 or 128 Kahn units). We know that 70 per cent of patients treated late will not become sero-negative before 5 to 10 years; many remain indefinitely sero-resistant.

Sero-resistance

Sero-resistance means an abnormal delay in the serologic response to treatment. It has serious significance only in early syphilis where the persistence after 9 months of a serum titre above dilution 1 in 8 (8 dils or 32 Kahn units) is indicative of therapeutic failure and of a possible involvement of the nerve

centres. An examination of the spinal fluid and retreatment are required in such cases.

Following treatment of late syphilis, a titre which remains above the level of 8 dils or 32 Kahn units for several years may appear to be relatively high. Nevertheless it is not to be considered a danger signal. In fact, statistics show that although relapses may occur after treatment of late syphilis, they are few and appear no less frequently in sero-negative patients than in those whose serums remain positive (5).

The slight significance to be attached to sero-resistance in late latent syphilis is understandable, if it is admitted that some individuals continue to produce reagin for years after the infection is cured, and that reagin, like a true antibody, may persist long after the infecting agent has been destroyed.

The Serologic Curve as an Aid in the Diagnosis of Syphilis

The possibility of technical and biological errors does not decrease in any way the value of the sero-diagnostic tests in syphilis, if a positive serology, unaccompanied by clinical symptoms, is confirmed by a series of blood examinations (6).

An isolated positive or negative report, which markedly differs from the preceding or following results, is usually the consequence of a clerical or technical error which can readily be corrected; it should be ignored.

Initial positive results which are followed by a spontaneous decline in the reagin titre as shown by a series of subsequent examinations, indicate a biologic false positive reaction due to some transient pathologic condition of the patient.

Among the most frequent causes of biologic false positive reactions we find:

(*a*) Upper respiratory infections, including common colds, and atypical virus pneumonia (5 to 20 per cent)

(*b*) Infectious mononucleosis (30 per cent)

(*c*) Smallpox vaccination (20 per cent)

(*d*) Infectious hepatitis (20 per cent)

Malaria and leprosy may yield a high percentage of false positive results, although they are no problem in our country nor are the tropical diseases due to treponemes similar to the *Treponema pallidum* of syphilis: Yaws, Pinta, Bejel (rat-bite fever may also be due to a spirochete and 20 per cent of infected individuals show false positive reactions).

As a general rule, most of the infectious diseases are apt to influence the serologic reaction of a few individuals who may normally have minute quantities of reactive substances in their blood. Whenever a blood test is found positive in a patient running a temperature, it should be controlled sometime after the temperature has become normal. Biologic false positives may persist for three months; a much earlier spontaneous decline in the reagin titre will readily differentiate between a transient false positive and a result due to syphilis. Furthermore, the serum titre is usually low in biologic false positive reactions; a syphilitic curve from an untreated patient remains at a fairly high and constant level in a series of tests, or shows a trend towards higher reagin titres.

The serum of a newborn may contain reagin from his syphilitic mother, carried through the placenta, without being himself infected with syphilis; his

positive serology should spontaneously revert to negative within three months. A child, however, whose serologic tests are positive at the end of three (and possibly even at the end of two months) is surely infected with syphilis.

A serious diagnostic problem is encountered in a small proportion of persons (one of 3,000 examined routinely) who show a persistently positive serologic test with normal clinical findings, normal spinal fluid and no history suggestive of syphilis. Excluding the possibility of congenital infection, if there has been no sexual exposure except to individuals who are free from every sign of syphilis, it is logical to conclude that the reaction is a biologic false positive; at least a definite diagnosis of syphilis should be excluded and the patient advised accordingly. Nevertheless, there usually remains a doubt; and it is desirable to insure protection of the person concerned by administering one course of penicillin. As yet, no laboratory procedure for differentiating between true and false positive serologic results has proved to be reliable; the one devised by Neurath deserves further investigation.

We are indebted to Dr. Robert E. Nelson for a valuable contribution to the understanding of the problem, if not, thus far, to its practical solution. He has demonstrated in the serum of syphilitic patients the presence of a specific antibody, distinct from reagin, which produces immobilization of virulent treponemes *in vitro* in the presence of fresh guinea-pig serum. Serums from known syphilitics are found to give positive immobilization tests; practically none has been reported with the serum from normal individuals. The complicated technique of the test makes it useful only for research; its diagnostic use awaits cultivation *in vitro* of the treponemes which has never been realized (7).

Undoubtedly the serologic tests will remain for a long time the only practical methods for detecting syphilis as well as for the control of treatment, but it should be emphasized that the truly positive results alone are of real significance.

The term "positive" should be applied only to clear-cut ++++ Wassermann and Kahn results, especially to high reagin titres. Weaker reactions, so far reported as 1 to 3 plus (+, ++, +++), are by no means to be interpreted as degrees of positivity. Reporting them as "inconclusive" or "doubtful" would eliminate confusion as to their significance; at most they raise a suspicion of syphilis and indicate the necessity of further investigation.

A doubtful blood result may lead to the finding of an abnormal spinal fluid. A weakly positive blood reaction associated with a primary lesion is always followed, within a few days, by a strongly positive result. In latent treated syphilis, weakly positive reactions which persist must be interpreted as negative.

Summary

The successful application of penicillin therapy to syphilis requires accurate determination of the reagin titres of positive serums. In recent infections successfully treated, the serologic titre falls within 6 to 9 months; it reaches low levels after 12 months in early latent cases; retreatment is indicated only for those that retain titres of 4 dils or more after this period.

Syphilis of more than 2 years' duration is usually sero-resistant because of the persistence in the blood of the antibody-like reagin long after the infection

is cured. There is no indication to warrant continued treatment of a patient who has a normal spinal fluid and no clinical signs for the sole purpose of reversing the serology to negative, even if it remains for years at a relatively high and constant level of positivity.

Biologic false positive reactions may be found repeatedly for 3 months after upper respiratory infections, atypical pneumonia, mononucleosis, vaccination, and a few other infections. A spontaneous and rapid decline of the serum titre will readily differentiate between a transient biologic false positive and a positive due to syphilis.

The term "positive" applies to clear-cut ++++ reactions, especially to high reagin titres. Reporting the weaker (++, +++) reactions as inconclusive or doubtful would eliminate confusion as to their significance; at most they raise a suspicion of syphilis; and if further search reveals no sign of infection, they are to be interpreted as negative.

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Some Administrative Aspects of the Integration of Health Services

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THE challenge to each public health worker has been concisely stated in the final paragraph of the Preamble to the Charter of the United Nations: "Governments have a responsibility for the health of their peoples which can be fulfilled only by the provision of adequate health and social measures."

Expanding public health budgets in every province, stepped-up tuberculosis control programs, newly developed cancer control programs, the establishment of provincial medical care programs for recipients of public assistance, the hospital care insurance programs in the three western provinces, and the establishment in 1948 of the National H alth Grants as the first stage of a national health insurance program, all constitute evidence of the sincerity and seriousness with which governments in Canada are assuming, step by step, the responsibility so clearly set forth in the Charter of which our nation is a signatory.

So far as the public health administrator is concerned, the expansion of and additions to provincial health programs have all had one effect, and that is to increase the number and complexity of the problems which daily confront him.

As a result of these expanding programs, the areas of contact with professional associations have been broadened; new segments of the population or perhaps the entire population have become involved with attendant problems of achieving public understanding and intelligent use of services; local interests and the needs of the province as a whole occasionally come into conflict as in the necessity of determining priorities for hospital construction grants; and the introduction of such new activities as a crippled children's program seems to set off a veritable chain reaction of new demands and new problems as unexpectedly large areas of unmet needs are revealed.

The types of problems which are created or intensified in a period of rapid development like the present vary in kind and degree from place to place. One of the major problems may be the shortage of qualified personnel, in other departments the chief problem may be budgetary, in yet another it may be the lack of public understanding of the objectives of an important program.

One problem, however, which is common to all developing programs is that of merging the new or expanded activities with the existing program so that a

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different and integrated pattern may be achieved. This is the task of marshalling one's forces, so to speak, so that they make a coordinated attack on the over-all health problem to ensure that the various parts of the program move forward side by side with no aspect of the program too far in front, no part lagging, no gaps in the frontal assault; in short, it is the problem of making certain that the health department's total program is an integrated and coordinated whole, in proper balance, and with no inconsistencies and no contradictions. This sounds like a tall order and, man-made institutions being what they are, perhaps impossible of complete achievement. Nevertheless, the over-all responsibility is there and what I wish to consider now are some of the ways in which the administrative organization can facilitate the achievement of the ideal. To narrow the discussion, I propose to consider the problem primarily from the point of view of a provincial health department and to use the recent reorganization of the Saskatchewan health department as an illustrative case history. I assure you that I do not use the Saskatchewan department as the ideal for reorganization took place only one year ago, and we have been experiencing growing pains ever since. I recognize also the difference between having a good administrative organization on paper and making it work.

There are, it seems to me, at least five major areas in which problems of coordinating and integrating health activities present themselves in a provincial department. That a number of these are duplicated on the municipal level was concisely brought out in yesterday morning's presentations. These major areas include:

(1) Relationships within the health department itself—what might be termed the problem of inter-divisional relationships.

(2) Relationships with other departments of government—as between health and welfare, between health and education, not to mention between health and the Treasury where you may not need integration, but you certainly need cooperation.

(3) Relationships between the provincial health department and the local health units.

(4) Relationships between the provincial Department of Public Health, the Department of National Health and Welfare and, probably, the health departments of bordering provinces.

(5) Relationships between the department and the professions and lay associations representative of the general public.

Problems within these areas are, of course, bound to differ from one province to another. For example, the problem of relationships between a provincial department and completely autonomous local county or municipal health units would certainly differ from those in a province where the local units are financed in large part by the provincial government and the health unit personnel have civil service status. And yet if one assumes that democratic administration prevails, that coordination is achieved by consent rather than by coercion, the difference is probably only one of degree.

Keeping in mind the limitations of time and the illustrations which this case history provides, it is necessary further to reduce the field of discussion

to three of these areas: within the health department, the health department and the local health regions, and the health department and the community.

The year 1944 was, as you will recall, a period of almost feverish interest in health insurance across Canada. It was at that time that, on the recommendation of a special survey commission (1), there was established in Saskatchewan as an advisory agency to the Minister of Health a Health Services Planning Commission of three members (Figure 1). This body was responsible, in general terms, for advising the minister on the development of health regions, medical and hospital care for recipients of public assistance, and experimental

DEPARTMENT OF PUBLIC HEALTH
Government of Saskatchewan, 1944

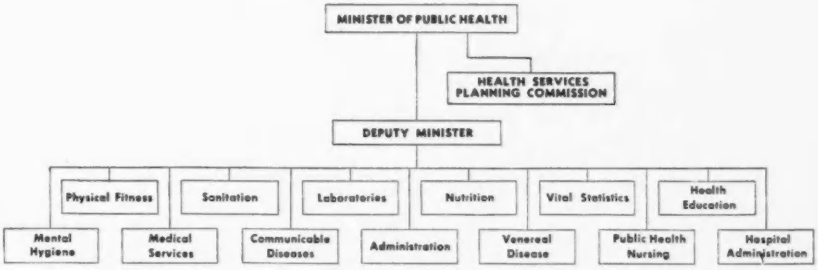

FIGURE 1. The Saskatchewan Department of Public Health, December, 1944. The Health Services Planning Commission has been established as a staff agency. The Deputy Minister of Public Health has 13 separate units reporting to him.

health insurance programs for the general population. The Commission was purely an advisory and planning group—what is termed a "staff" agency.

By 1947, four new programs had been introduced in Saskatchewan: hospital construction grants, medical and hospital care for old age pensioners and related groups, hospital care insurance for the entire population, and a prepaid medical care program in one health region. Responsibility for administration of the first three of these programs and approval of regional and municipal medical care programs had been assigned to the Health Services Planning Commission. The Commission consequently ceased to be purely a staff agency and became a "line" agency, responsible for the administration of operating programs. There were, in effect, two health departments, each responsible to the same Minister. The necessity for coordination was recognized through the appointment of the deputy minister of Public Health as a member of the Commission (meanwhile expanded to five members) and by having the director of the new Division of Regional Health Services responsible to both the deputy and the chairman (Figure 2). Some additional degree of coordination was achieved, of course, by the Minister, but you will agree that the task of administrative coordination is certainly not one which should ever need to be resolved at the ministerial level.

The need for a more rationalized organizational structure was widely recognized. Both the deputy minister and the chairman of the Commission had suggested that a comprehensive administrative analysis be undertaken. In 1948,

this analysis was begun by the Administrative Management Division of the Budget Bureau, and completed in 1949. Its major recommendation that there be a single health department was formally implemented on April 1, 1950, following appropriate changes in the legislation at the 1950 Session of the Legislature.

The department is now organized in accordance with sound and widely accepted principles of public administration (Figure 3).

(1) There is recognition of the principle of integration, that is, the necessity of grouping similar activities in one unit—what has been termed "an antidote to administrative anarchy."

DEPARTMENT OF PUBLIC HEALTH
Government of Saskatchewan, 1948

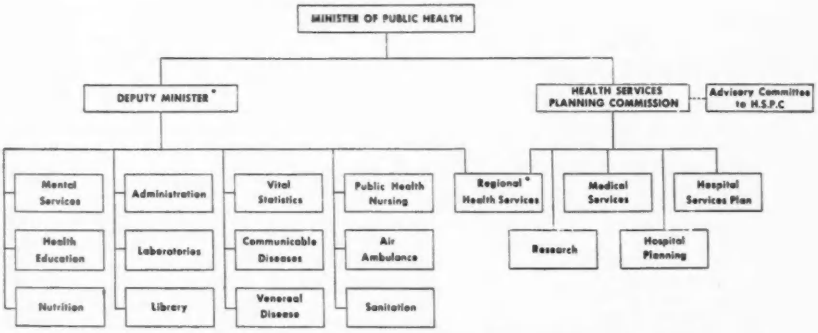

FIGURE 2. Public Health Department and Health Services Planning Commission organization, December, 1948. Note that, in contrast to 1944, the Commission is now an administrative "line" agency. Asterisks (*) indicate the persons who, in addition to the chairman, are members of the Commission. The Director of Regional Health Services is responsible to both agencies.

(2) There is recognition of the principle of hierarchy, or the "scalar process," whereby through lines of authority and responsibility every unit and person in the organization is answerable ultimately to the chief administrative officer.

(3) The number of branches has been kept to a minimum in order to permit the deputy to have an effective "span of control" by limiting the number of subordinates who report directly to him. Actually, the number is still too large. Most qualified observers in public administration practice believe that the number should not exceed six or seven.

(4) The nature of the activities of each of the 25 divisions has been taken into consideration in grouping these divisions into branches, each of which represents a major purpose or function.

(5) A distinction has been made between the different types of functions of the various branches.

(*a*) The operating or "line" activities are grouped in the Psychiatric Services Branch, the Medical and Hospital Services Branch, the Preventive Services Branch, and the Regional Health Services Branch.

DEPARTMENT OF PUBLIC HEALTH
Government of Saskatchewan, 1950

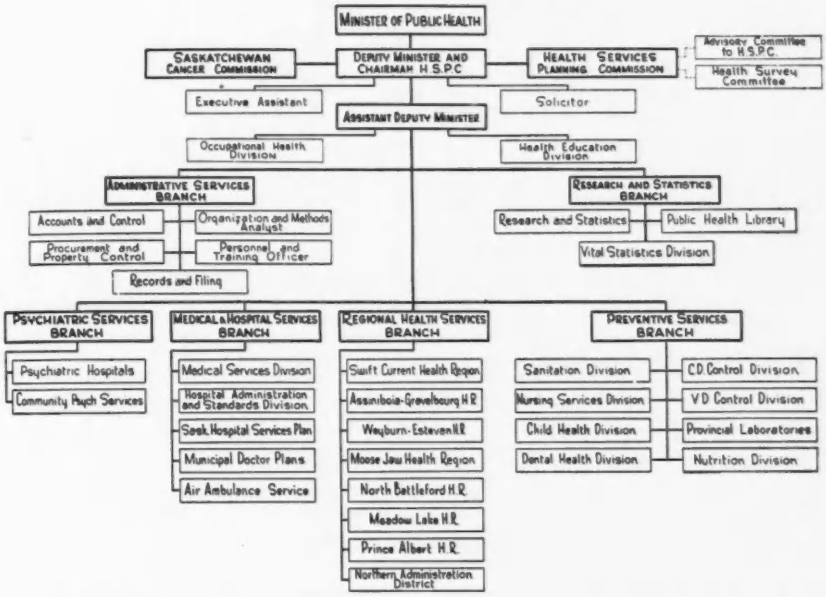

FIGURE 3. The Saskatchewan Department of Public Health, 1950. All divisions have been grouped according to function in six major Branches. Four of the Branches are "line" units, responsible for operating programs; one is an "auxiliary service" unit, facilitating the administration of all other Branches; the third is a staff agency" with responsibility for statistics, research, planning, surveys, and reports. Note that the maximum "span of control" is eight (in Preventive Services).

(*b*) The auxiliary services, essential to management control—including budget control, personnel, accounting, and purchasing—are grouped in the Administrative Services Branch. In addition, an administrative analyst, with training in administrative organization and methods, has been permanently assigned to the department to scrutinize procedures constantly in order to achieve more efficient administration.

(*c*) Vital and health statistics, research and planning studies, surveys of various kinds, and similar staff functions have been grouped in the Research and Statistics Branch.

(6) The Regional Health Services Branch has been established as a channel to and from the field and is, as such, a coordinating office for the integration of policy and activities at the provincial and local levels. This branch thus plays a new kind of role—a key role, you might say—because health services which were previously administered by the central department have now been decentralized to local regions. This means not only better health services for the people but should provide continuing assurance that the people will participate in the solution of their health problems at the local regional level.

What became of the Health Services Planning Commission? The Commission simply reverted to its original function as an advisory, planning, and recommending agency when the "line" functions it had assumed in 1946 and 1947 were incorporated in the unified health department. It is now composed of four members of the department—the deputy, the director of regional services, the director of hospital administration, the director of research and statistics, and the deputy provincial treasurer who was one of the original members appointed in 1944.

The Commission recommends on such major policy and administrative matters as approval of medical care contracts, grants to hospitals, methods of payment under the Hospital Services Plan, establishment of regions, and the like. It also facilitates the integration of the over-all program by providing a regular forum for discussion of new policy proposals by all branch heads who may be affected or involved.

By combining the two departments in one and by organizing it in accordance with sound principles of public administration, the task of integration in two of the areas I mentioned—intra-departmental integration and department-local health unit integration—has been enormously simplified with, I believe, already discernible results in terms of a better coordinated program.

Moreover, I believe you would concur in the proposition that this amalgamation was not only sound in terms of principles of public administration, but sound also from the point of view of good health administration. If, as is generally agreed, there is a general merging between preventive and therapeutic medicine, then it would seem to be desirable not to freeze the two into separate administrative compartments, perpetuating what is at best an artificial dichotomy.

We come now to the third area in which I believe consideration of the administrative aspects—the framework for action—can contribute to the success of the total program. It is an area in which a new experimental pattern may be emerging, and has to do with the relations of the provincial department to the community, that is, to the professions and lay associations representative of the general public. Such relationships become increasingly important as public health activities develop so as to serve a greater proportion of the community.

The relations of these two groups, sometimes referred to as the producers and consumers of health services (although I believe this gives an erroneous impression of the nature of good health care), give rise to certain questions. These questions arise, I believe, because of our changing concept of democratic government which has long been held to be government by the consent of the governed. What we are gradually recognizing, however, is that, as Mary Follet has so aptly stated, consent is not enough: "*not consent but participation* is the right basis for all social relations" (2).

Shortly after the appointment of the Health Services Planning Commission in 1944, there was also appointed an Advisory Committee to the Commission. Unfortunately, it seems to me, this committee became too large and unwieldy to enable its 34 members to bring to the Commission the full contribution of which they were capable.

Early in 1949, to assist the Health Services Planning Commission in the carrying out of the Health Survey, a 12-member committee was appointed. This

included five representatives from the health professions and the hospital association; five from the general public representing municipal organizations, farm, labour, and women's groups; and two members of the Planning Commission, the chairman, and the director of research who also serves as secretary. This committee has held a large number of meetings and every member has become intimately concerned with practically every aspect of health affairs in the province. There are at least two obvious results: the first, a minor one, is that it has made the health survey a much more lengthy process as we strive for agreement on every point; the other is that the health survey report will be a much more useful document, at least for Saskatchewan, since its production has been participated in by representatives of those groups which will be affected by the developing health program.

Furthermore, this process of having regular meetings of physicians, dentists, nurses, hospital people, representatives of the government, and representatives of those whom they serve, has produced a conviction which is, I believe, shared by all of us—that this is something we must not lose, that here we are achieving integration by participation. As a result, the Minister has recently proposed (3) that the present Health Services Planning Commission, which is now composed of five government members, be expanded to 15 by the addition of representatives of the professions and the public. When the work of the Survey Committee is finished, I think there is every likelihood that the new Commission will be established and, I am sure, all are optimistic concerning the contribution it can and will make to the health program of the future.

These, then, are three areas of health department activity where attempts have been made to provide the administrative structure which will facilitate a better integrated and better coordinated program.

It is true, of course, that the establishment of the organizational relationships is only a part of what is being recognized as the dynamic process of administration. As one writer has expressed it, "Skill in administration consists not only in building organizational machinery which is adapted to the work to be done but also in so dealing with the human parts of the machine that they all work at their individual or collective best" (4).

This observation would, I think, be confirmed by the experience of everyone here. But, assuming that our administrators *will* provide the dynamic leadership required to make the parts function, it is essential that the machine be properly designed so that all parts can work in harmony to achieve established goals of the health program.

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The Effect of pH on the Agglutination of *Salmonella typhosa* in Human and Rabbit Antisera

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IN attempts to prepare standardized agglutinable suspensions of *Salmonella typhosa*, it was observed that certain human sera, taken from active cases of typhoid fever, failed to react with these suspensions. While it is realized that antibodies may be absent from the serum of a patient with an active infection, these same sera did give positive reactions with standard suspensions obtained from the Oxford Laboratories. Examination showed the Oxford suspensions to be of a lower pH than the Laboratory of Hygiene suspensions. By adjusting the pH of the latter suspensions to that of the Oxford suspensions, positive results were obtained.

Procedure

Rabbits were immunized with H and O vaccines of *Salmonella typhosa* using the standard strains H901 and O901, and the antisera secured.

The human sera used in this study were obtained from cases of active typhoid infections as well as from healthy persons immunized with T.A.B. vaccine.

Space does not permit entry of all observations made, but as parallel sera gave almost identical results, those shown may be considered to adequately represent the phenomena taking place. The results obtained with two rabbit antisera R3(H) and R2(O) where H and O indicate the vaccine used, and two human sera H3 from an active infection and H6 from an immunized male, are described.

The antigen suspensions employed were prepared from the H901 and O901 strains. H suspensions were prepared by passaging H901 on a semi-solid medium to enhance motility, seeded on to the surface of Roux bottles containing Veal Infusion Agar and harvested in formalinized saline. O suspensions were also prepared by culturing in Roux bottles, using a young culture of the non-motile strain, O901. The O suspensions were alcohol-treated and resuspended in formalinized saline. Concentrates of the treated suspensions were stored, subsequently diluted in a series of sodium phosphate isomolar buffer solutions and adjusted to an opacity equal to that of a No. 3 McFarland

Presented at the eighteenth annual Christmas meeting of the Laboratory Section, Canadian Public Health Association, held in the Chateau Laurier, Ottawa, on December 18 and 19, 1950.

standard, or approximately 900 × 10^6 organisms/ml. Density determinations were made with an electrophotometer.

The buffer system recommended by Hendry (7) was employed, using the two phosphates of sodium (NaH_2PO_4 and Na_2HPO_4). By mixing solutions of these two salts (.061M and .0254M respectively) in quantities determined with the aid of a graph, sixteen levels of pH were obtained between the values of 5.0 and 8.0, with the values showing a difference of approximately 0.2 between adjacent members of the series.

Examination showed that the concentration of electrolyte decreased with increase in pH. As the highest concentration occurred in the mixture of lowest pH, it was to this level that the molarity of the remaining members of the series was corrected by the addition of appropriate amounts of sodium chloride. By this means all suspensions were adjusted to the same molarity, and thus variation in electrolyte concentration could be eliminated as a possible factor affecting agglutination.

Preliminary agglutination tests seemed to indicate that the highest degree of agglutination occurred at pH 6.68 for H and pH 6.31 for O. Consequently suspensions at these levels were used in determining the agglutinin titres for each serum employed. The end point selected was the last trace of agglutination visible to the naked eye. This was given the value *1+*. Six degrees of agglutination were discernible and thus the symbol *6+* was used to represent total or complete agglutination. The numerals between one and six represented the intermediate stages.

H tests were read after 2 hours at 50-52°C., while the O tests were recorded after 18 hours at the same temperature. All readings were made with the aid of gelatine standards, which were prepared for both the H and O types of agglutination showing the six different stages.

The drop technique, originally elaborated by Donald (1, 2, 3), was used in setting up dilutions. The system of recording serum dilutions was by a

TABLE I

DILUTION SYSTEM AND ITS CONSTITUTION

1 drop = .025 ml.

Number of tube		1	2	3	4	5	6	7	8	9	10
Drops of Serum dilution Tx10		10	9	8	7	6	5	4	3	2	1
Drops of diluent (saline)		10	11	12	13	14	15	16	17	18	19
Volume of dilution	Drops	20	20	20	20	20	20	20	20	20	20
	ml.	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Antigen added. ml.		0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Total volume per tube. ml.		1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Final diln. in terms of titre		Tx2.5	Tx2.25	Tx2	Tx1.75	Tx1.5	Tx1.25	Tx1	Tx.75	Tx.5	Tx.25

method first worked out by Murray (8), for its convenience in establishing a series of dilutions all relative to titre, and because it provided a ready means of comparing agglutination in the different antigen-antibody systems. Table I shows the harmonic series of dilutions selected and the method of setting it up. The dilution recognized as titre, previously determined for each serum, occurs in the same tube for each test.

Agglutination is expressed as a percentage, and since pH 6.68 and pH 6.31 were the levels selected for titre determinations, agglutination at these levels was considered to be 100 per cent. Agglutination at other levels of pH was calculated by totalling the number of plusses for each test and expressing the total as a percentage of titre (see example, Table II).

TABLE II

SHOWING METHOD OF DETERMINING PERCENTAGE AGGLUTINATION FOR EACH REACTION

pH of antigen-antibody system	Serum dilutions										Total	% Aggln.
	Tx2.5	Tx2.25	Tx2	Tx1.75	Tx1.5	Tx1.25	Tx1	Tx.75	Tx.5	Tx.25		
5.11	5	5	4	4	3	2	0	0	0	0	23	76.6
5.73	6	5	5	5	4	3	1	0	0	0	29	96.6
6.68	6	6	5	5	4	3	1	0	0	0	30	*100*
7.40	6	5	4	4	2	0	0	0	0	0	21	70
8.14	4	3	2	*1	0	0	0	0	0	0	10	33.3

EXPERIMENTAL RESULTS

Rabbit antiserum R3 (H)

The crude serum was tested for both H and O agglutinins. pH showed its greatest depressing effect on H agglutination in the range below 6.31, while a slight depression was also in evidence between pH 6.68 and pH 7.22, after which the percentage remained constant. In O agglutination pH appeared to exert a slight depressing effect at both ends of the range, with the effect more marked in the lower levels of pH. Maximum O agglutination was experienced in the range pH 6.68-7.58.

By absorption with O901 (IX, XII; ——) the O agglutinins were removed and the serum tested specifically for its H reaction (Fig. 1). It was found that the percentage agglutination was boosted over the range and the optimum level was extended to pH 8.14.

By absorbing with *S. manhattan* (VI, VII; d—) the H agglutinins were removed, and when the serum was tested for specific O (Fig. 2) no significant change was found in the percentage agglutination, but the optimum level was extended on both sides of the crude level.

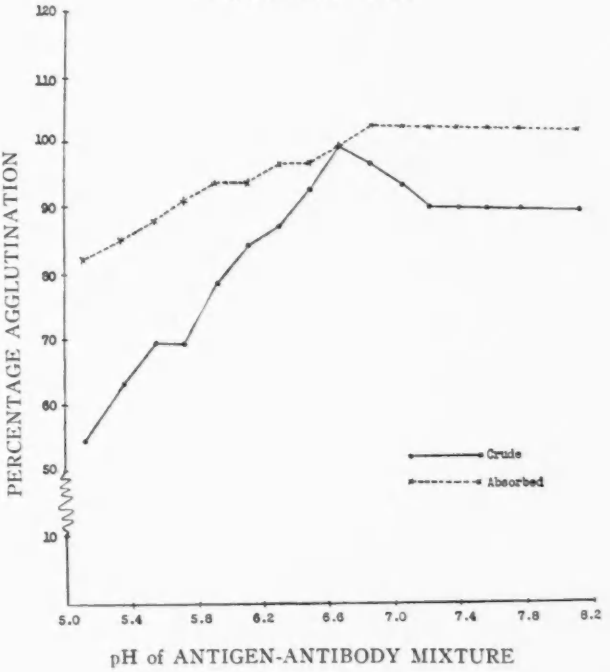
Rabbit antiserum R2 (O)

The depressing effect of pH on agglutination in this serum was again most noticeable in the lower levels of pH (Fig. 3). The level of H agglutinins in this serum was very low and was not detectable in the dilutions used for the O

FIGURE 1

Showing the effect of pH on H agglutination of S. typhosa in rabbit antiserum R3(H)

H agglutinin titre 1:3600



reaction. The pH effect here is not unlike that exhibited by the O reaction in serum R3 (H) (Fig. 2).

Human Serum H3 (Case)

This serum, obtained from an active case of typhoid, presented quite a different picture. Showing almost the reverse effect of that found in rabbit antiserum, the greatest depression of H agglutination was found in the higher levels of pH, 7.06-8.14 (Fig. 4). The optimum level lay between pH 5.92 and pH 6.68.

The effect of pH was even more marked in O agglutination where depression was greater at both ends of the range, but the greatest depression occurred in the higher levels. At pH 5.11 the percentage dropped to 53, while at pH 8.14, agglutination was nil. The optimum level appeared to be between pH 6.12 and 6.49 (Fig. 5).

Removal of the O agglutinins by absorption, as above, narrowed the optimum range slightly but had little other significant effect (Fig. 4).

FIGURE 2

Showing the effect of pH on O agglutination of S. typhosa in rabbit antiserum R3(H)

O agglutinin titre 1:2880

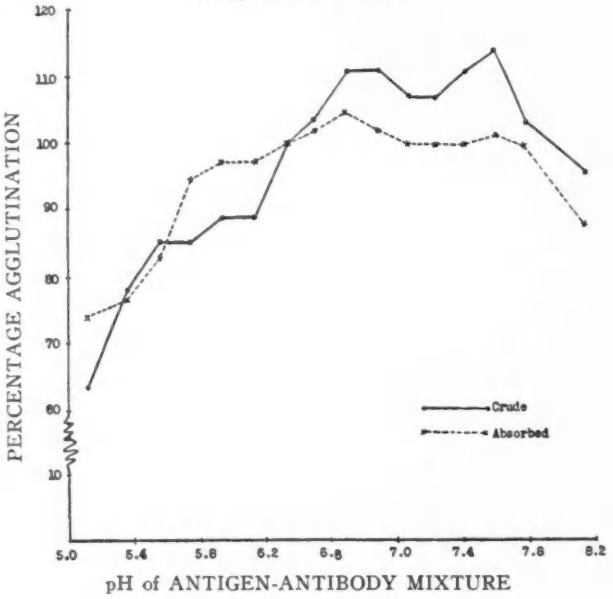


FIGURE 3

Showing the effect of pH on O agglutination of S. typhosa

O agglutinin titre 1:5500

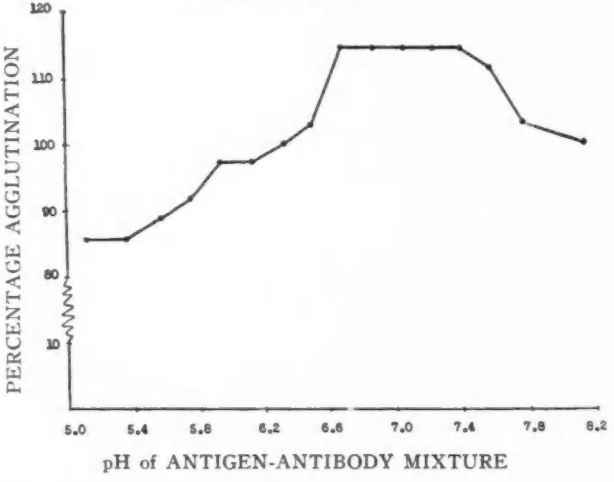
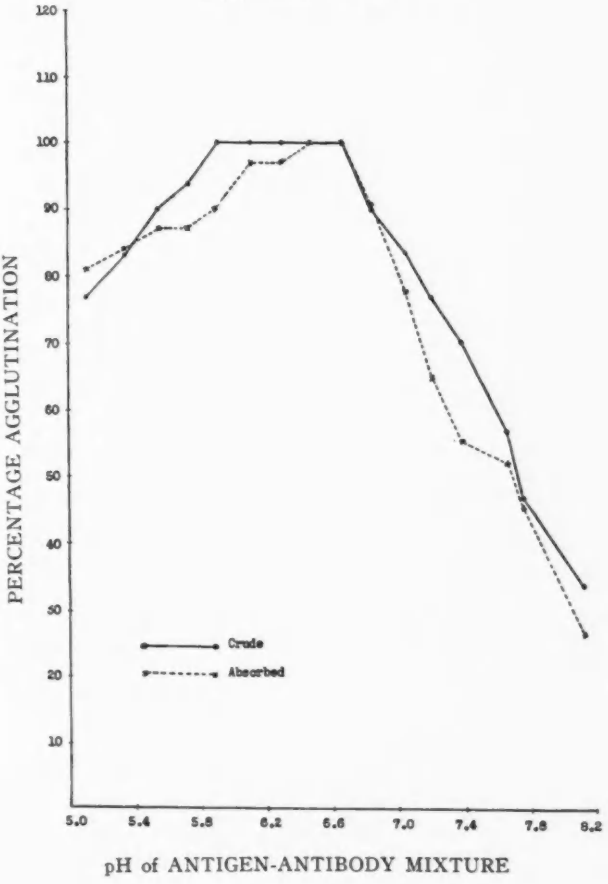


FIGURE 4

Showing the effect of pH on H agglutination of S. typhosa in human positive serum H3

H agglutinin titre 1:480



Human Serum H6 (T.A.B.)

In this serum, taken from an immunized male, pH did not appear to exercise any great depressing effect. O agglutinins were conspicuously absent from this serum, and the only noticeable effect on H agglutination was in the range pH 6.86 to 8.14. The optimum level lay between pH 6.12-6.68.

DISCUSSION

From the data presented, it appears that the effect of pH on the agglutination of suspensions of *S. typhosa* varies with human and rabbit antisera. In human positive sera pH has its greatest effect on agglutination

at the levels above neutrality. Depression of O agglutination was well marked in both the higher and lower levels of the pH range, although the greatest depression was between pH7 and 8. Absorption of the O agglutinins from human sera had little significant effect on H agglutination at the different pH levels.

In the serum from immunized persons the effect of pH was mild and only noticeable between pH 6.86 and 8.14. Agglutination was depressed only to a level of 75 per cent of the titre of the serum from an immunized person, while in the positive serum it dropped as low as 33 per cent for H, and 0 per cent for O at pH 8.14.

Rabbit sera exhibited the reverse effect of that experienced in human sera; i.e., the greatest depression of agglutination occurred in the lower levels

FIGURE 5

Showing the effect of pH on O agglutination of S. typhosa in human positive serum H3

O agglutinin titre 1:300

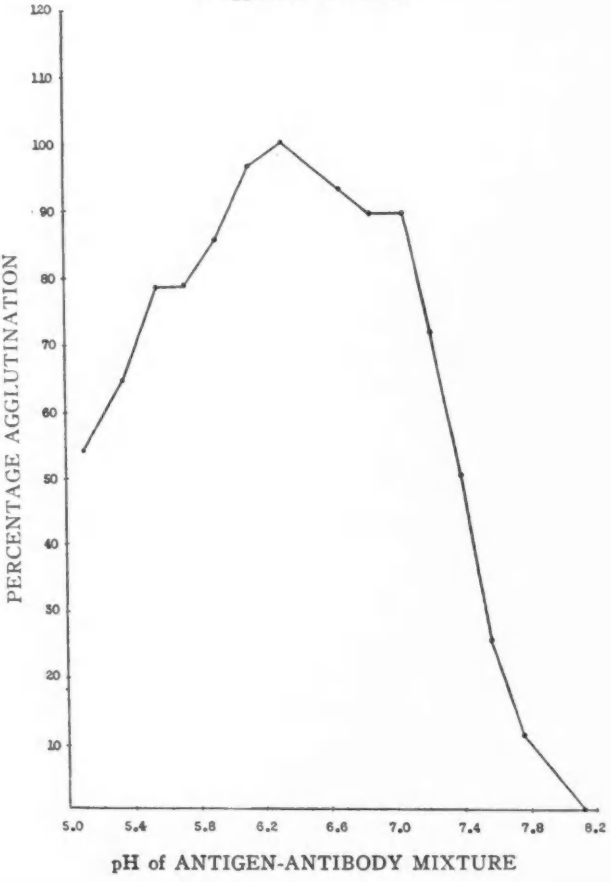
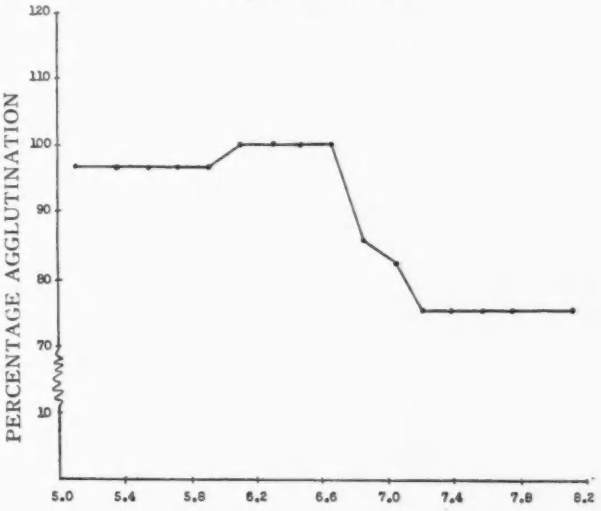


FIGURE 6

Showing the effect of pH on H agglutination of S. typhosa in human immune serum H6

H agglutinin titre 1:600



of pH. The depression was not as marked correspondingly as in human positive sera. Absorption of agglutinins resulted in a mild boost of percentage agglutination and a slight extension of the optimum pH level.

The optimum range for the performance of agglutination reactions with *S. typhosa* in rabbit antisera appears to be pH 6.3 to pH 7.7, while the range narrows to pH 6.1-6.8 in human positive sera. Agglutination in human positive sera rapidly falls off above pH 6.8.

Tullock (9, 10) in 1918 commented on the presence of some inactive substances in serum that would cause an inhibition of agglutination if the reaction of the menstruum were too acid or too alkaline. Unfortunately the nature of these substances is presently unknown, but they may be worthy of consideration.

Hayes (5, 6) claimed that rabbit antisera could not be relied on for standardizing suspensions of *S. typhosa* due to the variability of the XII_2 component of the O antigen XII. The immune response to this component varies and may be entirely absent in human beings. Hayes suggested the use of serum from immunized persons in preference to rabbit antiserum for standardizing suspensions. Sera from immunized individuals, however, do not exhibit the suppressed reaction in the higher pH levels, 7-8, experienced with human positive sera, although the optimum pH level corresponds fairly well in the two sera.

From the results obtained, however, it seems doubtful that the differences

existing in the agglutinability of suspensions of this organism in human and rabbit antisera, in the range above pH 7.0, are due to antibody variability.

Felix (4), in co-operation with H. J. Bensted, has suggested the establishment of international standard antisera for the purpose of standardizing diagnostic agglutination tests for typhoid and paratyphoid fevers. The author is inclined to agree with his comment that in the routine diagnosis of these fevers there is no room for consideration of the partial antigens into which the O antigens have been split according to the Kauffmann-White Schema. The serum suggested for the international standard is horse serum. To date we are not familiar with the reaction in horse serum compared with that in human positive serum. An investigation along these lines should be carried out before the horse serum standard is established and distributed.

It is thus felt that with the increasing need for the establishment of such standard antisera for checking the agglutinability of suspensions used in the Widal test, attention should be given to the pH at which the diagnostic reaction is performed. With the knowledge of the effect of pH on these reactions, the use of the international standard could be more clearly defined.

Summary

1. A convenient buffer system, based on the work of Hendry, for the control of pH in the preparation of H and O suspensions is briefly outlined.

2. The optimal range of pH for agglutination of *S. typhosa* in human and rabbit sera is illustrated.

3. The effect of agglutinin absorption on agglutination was also studied in an effort to determine any "blocking" effects.

4. All tests were read with the aid of gelatine standards by reflected light against a dark background.

5. A convenient method used in making serum dilutions and recording results of the agglutination reaction is shown.

Acknowledgments

This study was made possible through collaboration between the Laboratory of Hygiene and the Department of Bacteriology, McGill University.

The author would like to thank Professor E. G. D. Murray, under whose supervision this work was carried out, for his many helpful suggestions in approaching the problem and his generous assistance throughout the project.

The human positive sera were obtained from Mr. J. M. Desranleau of the Quebec Ministry of Health, whose cooperation is appreciated.

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Canadian Journal of Public Health

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THE SHORTAGE OF PUBLIC HEALTH NURSES IN CANADA

THE EXECUTIVE COUNCIL of the Canadian Public Health Association undertook, as its major project in 1946, a study of the serious lack of public health personnel in Canada. To quote the Report of the Study Committee on Public Health Practice: "As the shortage was most acute amongst physicians and public health nurses, it was decided to study the practices of these two groups. The Executive were of the opinion that studies of the actual work being done by physicians and nurses in official health agencies in Canada would be of value in assessing the factors, other than salary, which had produced the shortage of trained personnel in Canada."

Has the report fulfilled the original objective? This is a difficult question to answer at this point, as it perhaps will be at any point in the future. However, throughout the report there are many recommendations that, if implemented, could do much to relieve this ever-increasing problem. Perhaps one of the most significant parts of the whole report is a short chapter near the end headed "Activity Analysis of Public Health Nursing".

This chapter provides no suggestion of what should be, either quantitatively or qualitatively; no ready answers; no clear-cut recommendations. Perhaps there is disappointment that the solutions are not there. The nurse members of the Canadian Public Health Association sought to find "what is essential public health nursing" long before this study was commenced, and hoped that it would clearly state the answer. However, after a liberal sampling of local health departments, the field workers state that "Due to variations in problems confronting local health departments and the resulting variety of nursing activities, it is impossible in this study to make more than general recommendations. From this point an assessment of 'the work that nurses now perform' must be done in each local situation through a job analysis." Here, then, is a clear statement of a method by which employers and employees can find some of the answers for themselves. The whole report provides excellent background material by which local findings could be interpreted and recommendations, supported by the strength and experience of the membership of the Canadian Public Health Association, on which reassignment of duties and personnel could be instituted.

Industry has long recognized the value of job analysis and evaluation as essential to efficient administration. Where their advice has been sought by other agencies, it has been readily given. A few public health agencies in Canada

have found that it need not be a complicated technical procedure, especially for a start. All it takes is willingness on the part of the administrator and staff to study together, utilize experience and advice available in practically every community, and then with determination resolve to put their findings into practice.

The report of the Study Committee on Public Health Practice in Canada does provide some of the answers to the shortage of public health nurses in Canada. However, it is necessary to work for them in the local situation. The agencies which have included a study of the report in their staff-education program, followed by or concurrent with an activity analysis of their public health nursing staff (as well as other personnel), confirm this. They have found also that discovering the solution to some of their problems is not the end—the necessary change has to be implemented; but the analysis is a start in the right direction. Add good professional relationships within the agency and duplicate the effort many times over across Canada, and the result could bring returns beyond the fondest hopes of the Canadian Public Health Association when the study was started back in 1946.

Helen G. McArthur.

THE PROVINCIAL ASSOCIATIONS

MUCH THOUGHT has been given by the Executive Committee to the functioning of the Canadian Public Health Association. It has long been recognized that it is not possible through the holding of an annual meeting of the Association once a year to make the Association vital to the members, as the great majority are not able to attend the sessions. During the past three years the Provincial Departments of Health have co-operated with the Association in making possible the organization of provincial public health associations. In Nova Scotia the existing organization of health officers is the nucleus for the new Nova Scotia Public Health Association which it is expected will be formally established in September. In Quebec, la Société d'hygiène et de médecine préventive de la province de Québec has been functioning for the past two years, and this year's national meeting of the Association was held in conjunction with it. In Ontario, the second annual meeting of the Ontario Public Health Association will be held in Toronto on October 1 and 2, at which time all those engaged in public health work in the province will have the opportunity of attending a well-planned, comprehensive program. In Manitoba, steps are being taken which it is hoped will culminate in the organization of a Manitoba Public Health Association next June, when the national meeting will be held in Winnipeg. The Saskatchewan Public Health Officials Association will become the centre of activity of the Canadian Public Health Association in that province. On September 4 and 5 the Alberta Public Health Association will hold its annual meeting in Edmonton. In British Columbia, further consideration is being given to the annual sessions of the public health personnel convened by the Provincial Department of Health and Welfare. In Quebec, Ontario and Alberta, joint membership in the Canadian Public Health Association and in the provincial organization has been arranged, and the fees do not reflect the current inflation.

The organization of provincial divisions is an important development in the Association, and through these associations the work of the national organization can best be carried forward.

ONTARIO PUBLIC HEALTH ASSOCIATION

SECOND ANNUAL MEETING

ROYAL YORK HOTEL, TORONTO

October 1 and 2, 1951

●

Directory of Sessions

MONDAY, OCTOBER 1

9.00 a.m.—Registration. Every delegate is expected to register. The fee is $2.00.
10.00 a.m.—Minister's Conference for Ontario Health Officers.
12.30 p.m.—Luncheon. Speaker: The Honourable Mackinnon Phillips.
2.30 p.m.—Section Meetings:
Section of the Ontario Health Officers Conference and Section of Public Health Nursing (combined session).
Veterinary Public Health.
Environmental Hygiene.
8.00 p.m.—Meeting of the Board of Directors, Ontario Public Health Association.
Meeting, Ontario Branch, Canadian Institute of Sanitary Inspectors.

TUESDAY, OCTOBER 2

9.30 a.m.—General Session.
12.30 p.m.—Luncheon followed by annual business meeting of the Association.
2.30 p.m.—Section Meetings:
Section of the Ontario Health Officers Conference.
Public Health Nursing.
Veterinary Public Health.
Environmental Hygiene.

●

Tentative Program

MONDAY, OCTOBER 1, 9.00 a.m.

REGISTRATION

All delegates are expected to register. The fee is $2.00.

MONDAY, 10.00 a.m.

MINISTER'S CONFERENCE for ONTARIO HEALTH OFFICERS

Presiding: DR. ROSS HARRIS, Director, Kirkland-Larder Lake Health Unit, and 1st Vice-President of the Association.

Address of Welcome. The HONOURABLE MACKINNON PHILLIPS, M.D., Minister of Health and Hospitals.

Recent Changes in Health Legislation.

Open Discussion of Current Problems.

Section Business.

MONDAY, 12.30 p.m.

Luncheon

Presiding: DR. ROSS HARRIS, Director, Kirkland-Larder Lake Health Unit, and 1st Vice-President of the Association.

Speaker: The HONOURABLE MACKINNON PHILLIPS, M.D., Minister of Health and Hospitals.

Tickets will be on sale at the Registration Desk from 9.00 a.m. Early reservations are desirable, as the accommodation is limited.

MONDAY, 2.30 p.m.

SECTION OF THE ONTARIO HEALTH OFFICERS CONFERENCE and SECTION OF PUBLIC HEALTH NURSING

(Combined Session)

Presiding: Dr. L. A. CLARKE, Medical Officer of Health, Hamilton, and Chairman of the Section of the Ontario Health Officers Conference; and Miss PEARL STIVER, Director of Public Health Nursing, Local Board of Health, Ottawa, and Chairman of the Public Health Nursing Section.

Program to be announced.

MONDAY, 2.30 p.m.

VETERINARY PUBLIC HEALTH SECTION

BUSINESS MEETING

MONDAY, 2.30 p.m.

ENVIRONMENTAL HYGIENE SECTION

Presiding: Mr. T. H. JACKSON, C.S.I.(C.), Chief Quarantine Officer, Department of Public Health, Toronto.

1. **Business.**
2. **Sanitation of Markets and Sales Barns.**
3. **Supervision of Septic-tank Installations.**
   R. G. McQUILLAN, Board of Health Engineer, North York Township.
4. **Restaurant Sanitation in a City.**
5. **Air-pollution Investigations.**

MONDAY, 8.00 p.m.

MEETING OF THE BOARD OF DIRECTORS

MONDAY, 8.00 p.m.

MEETING OF THE CANADIAN INSTITUTE OF SANITARY INSPECTORS

(Ontario Branch)

TUESDAY, OCTOBER 2 - 9.00 a.m.

GENERAL SESSION

Presiding: Dr. ROSS HARRIS, Director, Kirkland-Larder Lake Health Unit, and 1st Vice-President of the Association.

Address. Dr. HARRIS.

Good Food for Expectant Mothers. E. W. McHENRY, Ph.D., Professor of Public Health Nutrition, University of Toronto.

Guided Discussion: Public Health—Past, Present, and Future.

Chairman: Dr. D. V. CURREY, Director, St. Catharines-Lincoln Health Unit.

(a) **The Past Ten Years or More.** Dr. CURREY.

(b) **The Present:**

Education versus Legislation. Dr. JOHN HOWIE, Medical Officer of Health, Windsor.

Relationship of Medical Officer of Health, Board and Municipal Administration. Mrs. MARY S. PETTIT, Chairman, Board of Health, Halton County Health Unit.

Adequate Clerical Help, One of the Most Valuable Assets in a Public Health Program. Mrs. I. E. MUNKITTRICK, Clerical Assistant, Welland and District Health Unit.

Sanitation, One Problem of Suburban Growth. Mr. F. L. LUNN, C.S.I.(C.), Sanitary Inspector, Peel County Health Unit.

How Should Nurses Divide Time in order to Give Maximum Service. Mrs. M. NORTON, Public Health Nurse, Brant County Health Unit.

Some Aspects of the Dental Contribution to the Public Health Program. GLEN T. MITTON, D.D.S., D.D.P.H., Associate Professor of Public Health Dentistry, University of Toronto.

Contribution of a Veterinarian to Public Health. F. J. HARDEN, D.V.M., D.V.P.H., Veterinarian, Prince Edward County Health Unit.

(c) **Public Health: The Challenge of the Future.** Dr. J. M. MATHER, Director, Halton County Health Unit.

NOTE: Following each presentation the speaker will answer SPECIFIC QUESTIONS for a period of five minutes.

TUESDAY, 12.30 p.m.

LUNCHEON FOLLOWED BY ANNUAL BUSINESS MEETING OF THE ASSOCIATION

TUESDAY, 2.30 p.m.

SECTION OF THE ONTARIO HEALTH OFFICERS CONFERENCE

Presiding: Dr. L. A. CLARKE, Medical Officer of Health, Hamilton, and Chairman of the Section.

The topics will include:

Antibiotics in the Public Health Field.
Vision Screening.
Newer Concepts in School Health Services.
A Case of Leprosy in a Canadian Immigrant.
The Newer Knowledge of Virus Diseases.

TUESDAY, 2.30 p.m.

PUBLIC HEALTH NURSING SECTION

Presiding: Miss PEARL STIVER, Director of Public Health Nursing, Local Board of Health, Ottawa, and Chairman of the Section.

Chairman's Remarks. Miss STIVER.

Business.

General Aspects of Civil Defence. AIR VICE-MARSHAL THOMAS A. LAWRENCE, Director of Civil Defence for Toronto and York County.

Report of Training Plans for Nurses in Civil Defence. Representative of the Planning Group in Civil Defence, Department of National Health and Welfare.

TUESDAY, 2.30 p.m.

VETERINARY PUBLIC HEALTH SECTION

Mastitis Control Program as a Means to Better Milk. Dr. RUSSELL DORLAND, Bruce County Health Unit.
Discussion. Dr. DAVID GARRICK, Simcoe County Health Unit.

Brucellosis Survey in Brant County. Dr. O. RAYMOND, Brant County Health Unit, and Dr. N. SANDERSON, New Liskeard.
Discussion. Dr. NORMAN FISH, Ontario Veterinary College.

Antibiotic Therapy of the Bovine and its Relationship to Milk. Dr. DON BARNUM, Ontario Veterinary College.
Discussion. Dr. W. R. MITCHELL, Halton County Health Unit.

Organization of Rural Meat Inspection. Dr. DON DAMUDE, Northumberland-Durham Health Unit.
Discussion. Dr. J. E. WATT, City of Oshawa Health Department.

TUESDAY, 2.30 p.m.

ENVIRONMENTAL HYGIENE SECTION

Program to be announced.

ONTARIO PUBLIC HEALTH ASSOCIATION

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